SPACECRAFT STRUCTURAL STRENGTH AND MATERIALS
ASTE 557
FALL 2015 SYLLABUS

Course Instructor: R. Brett Williams, PhD, PE
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COURSE SCOPE AND OBJECTIVES:

This course is geared towards graduate-level engineers with diverse technical backgrounds who are working professionals in the aerospace industry and desire a course focused on the structural strength design and materials selection aspects of spacecraft development. Upon completion of the course, students will be able to understand the scope of work being performed by mechanical/structural teams and be able to interact with them in a more productive and knowledgeable manner. Lectures focus on general concepts applicable to all spacecraft designs but reinforce ideas with real-world examples.

The objective of this course is to discuss and understand the following topics:

- Roles and responsibilities of the structural design team members.
- Spacecraft structural design process, concepts, and examples.
- Selection of materials used in spacecraft, including analysis of composite materials.
- Classical strength analysis techniques used by structural designers and analysts.
- Finite Element Method (FEM) software as a tool to the structural analyst.
- Structural testing to verify requirements.

COURSE FORMAT:

Fall 2015 – 15 course meetings including Final Exam, Mondays 6:40-9:20pm
Dates: 24 August 2015 – 30 November 2015, Final Exam 14 December 2015.
On-Campus Location: OHE-120
Additional Notes: Course available through USC Distance Education Network (DEN).

COURSE GRADING:

Semester Project (Due 23 November 2015):	14%
Homework (Due Weekly per syllabus, 12 sets, 3% each):	36%
Mid-term Exam (In-Class, Monday 19 October 2015, 640-920pm):	25%
Final Exam (In-Class, Monday 14 December 2015, 7-9pm):	25%
Total:	100%

REQUIRED TEXT AND MATERIALS:

- Instructor's Course Notes posted on Blackboard

OPTIONAL REFERENCE TEXTS:

- *Spacecraft Structures and Mechanisms: From Concept to Launch* by Thomas P. Sarafin(ed) Space Technology Library, 1995 (fourth printing, 2003) **Paperback Acceptable!**
- *Mechanical Behavior of Materials, 3rd Ed.* by Norman E. Dowling, Prentice Hall, 2006

- *Mechanics of Composite Materials, 2nd Ed.* by Robert M. Jones, Taylor & Francis, 1999
- *Roark's Formulas for Stress and Strain, 7th Ed.* by Warren Young, McGraw-Hill, 2001
- *Formulas for Natural Frequency and Mode Shape* by Robert D. Blevins, Krieger Publishing Company, 2001

SESSION-BY-SESSION OUTLINE:

Class	Date	Topic	Homework Due
1	24-Aug	**Course Introduction and Intro to Spacecraft Structures Development:** Overview of design process, structures team roles and responsibilities, trade studies, key design considerations, requirements	-
2	31-Aug	**Spacecraft Environments and Material Selection for Spacecraft:** Environmental loads on spacecraft, Common materials, material properties and testing	1
-	7-Sep	**Labor Day** Class Does Not Meet	2
3	14-Sep	**Spacecraft Configuration Design:** Configuration design of subsystem hardware, system mass property calculations	**Project Proposal**
4	21-Sep	**Conceptual Design of Spacecraft:** Common types of structures, kinematic mounts, methods of attachment	3
5	28-Sep	**Strength of Materials I:** Truss analysis, stress and strain definitions, linear elasticity, static failure theories	4
6	5-Oct	**Strength of Materials II:** Properties of areas, beam bending, column buckling, torsion, pressure vessels	5
7	12-Oct	**Strength of Materials III, Midterm Review:** Fatigue and fracture, plates and stiffened panels,	6
8	19-Oct	**Midterm Exam:** In-Class, On CAMPUS, 640-920PM	**Midterm**
9	26-Oct	**Structural Dynamics I:** Introduction to Structural Dynamics and Vibrations	7
10	2-Nov	**Mechanics of Composite Materials I:** Introduction, fabrication methods, stiffness analysis of laminae, micromechanics	8
11	9-Nov	**Mechanics of Composite Materials II:** Stiffness analysis of laminates, special laminates, sandwich laminates	9
12	16-Nov	**Structural Analysis using Finite Element Method:** FEM basics, element types, stiffness matrix, pre and post processors, solvers. FEM Software examples.	10
13	23-Nov	**Fasteners and Joint Design: (Professor on Travel - no in-class meeting)** Intro. to fasteners, bolted and riveted structures, welded and adhesively-joined structures	11, **Projects Due**
14	30-Nov	**Structural Testing, Final Exam Review, Project-related Final Exam Given** MSL Structural Testing examples, static load testing, modal testing	12
-	7-Dec	**Study Day** Class Does Not Meet	-
15	14-Dec	**Final Exam:** In-Class, ON CAMPUS 7-9PM	**Project-Related Final**

Statement for Students with Disabilities
Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.-5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

Statement on Academic Integrity
USC seeks to maintain an optimal learning environment. General principles of

academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. Scampus, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: http://www.usc.edu/dept/publications/SCAMPUS/gov/. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/.